



Fermilab Optical Links Activities and Interests

Fermilab
Computing Division/Electronic Systems Engineering

Outline



Past and Current Projects

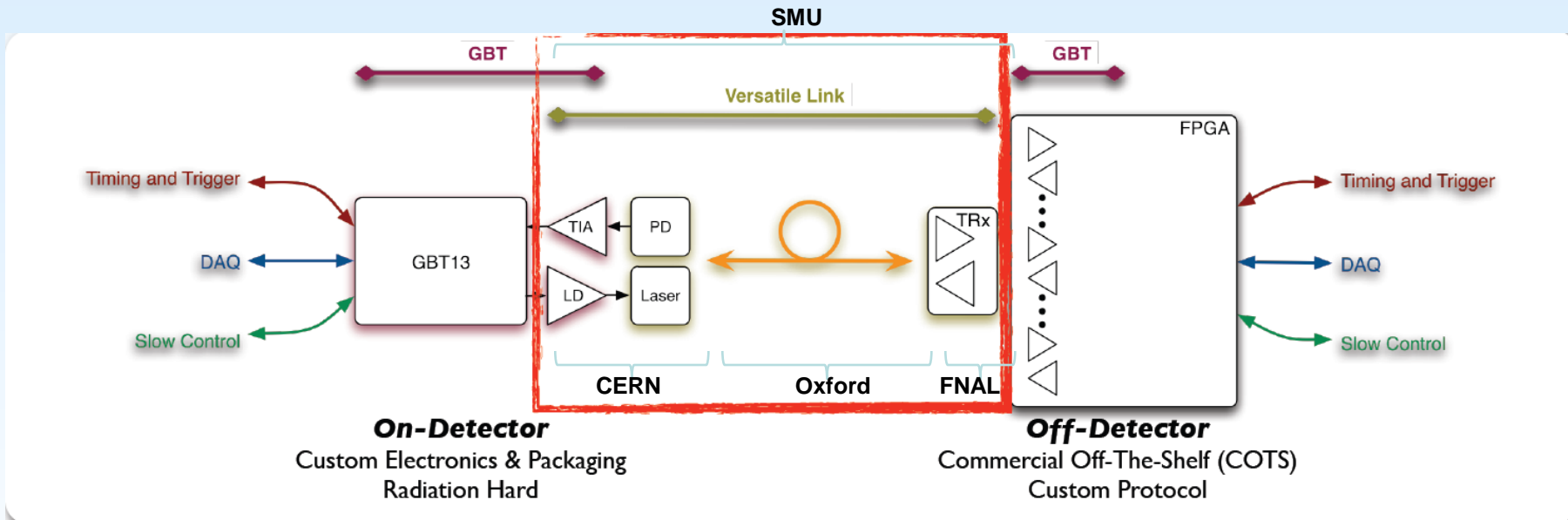
Test Systems and Components

Future Directions & Interests

Versatile Link Common Project



Versatile Link: CERN-organized common project for ATLAS and CMS
Goal: “Development of a general purpose optical link which can cover all envisioned transmission applications: a versatile link” @ data transfer rates of up to 5 Gbps.



- Work Package 1.1 (Southern Methodist University)
 - Point to Point Architecture and System Engineering
- Work Package 2.1 (CERN)
 - Front End Components (Versatile Transceiver)
- Work Package 2.2 (Fermilab)
 - Back End Components (COTS, Off Detector Components)
- Work Package 2.3 (Oxford University)
 - Passive Components

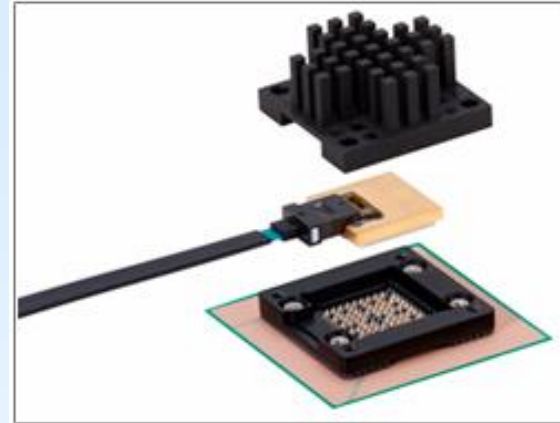
*Source: “Versatile Link Status Report”
Jan Troska
CMS Tracker Upgrade Meeting
April 24, 2009*

*See TIPP 2011 Presentation Dr. Annie Xiang, “A Versatile Link for high speed radiation, resistant optical transmission in LHC upgrades”

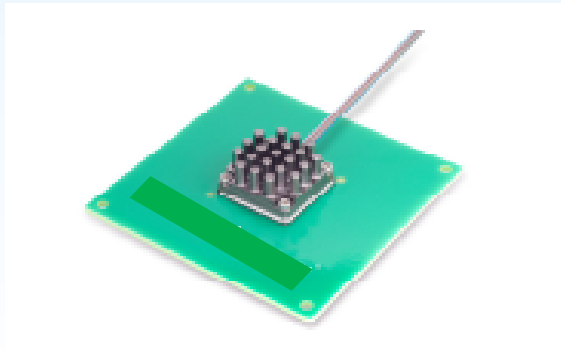
Parallel Optics – Emerging OE Products



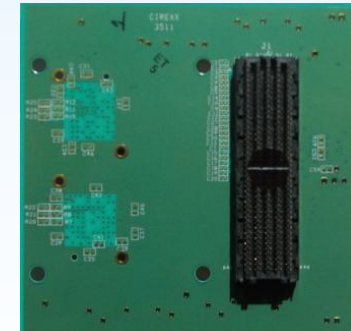
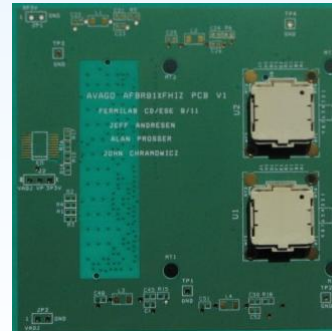
Parallel Optical Engine Tx/Rx
(12 channels, 10 Gbps/channel)



Parallel Optical Engine Tx/Rx
(12 channels, 10 Gbps/channel)

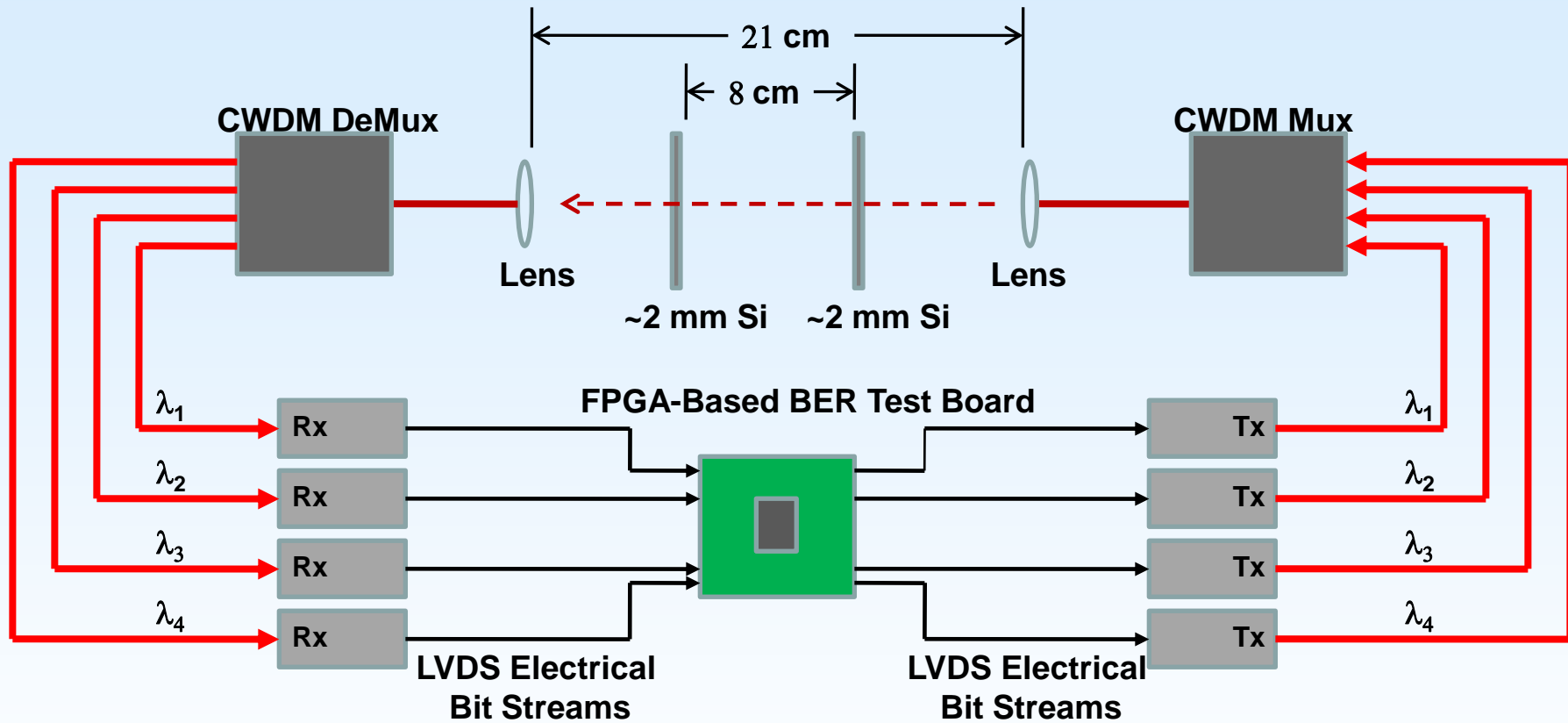


Parallel Optical Engine TRx
(12 channels, 10 Gbps/channel)



FMC Test Card
12 Channel Tx/Rx Optical Engine

CWDM/Free-Space Bit Error Rate Testing With Vega Wave Systems



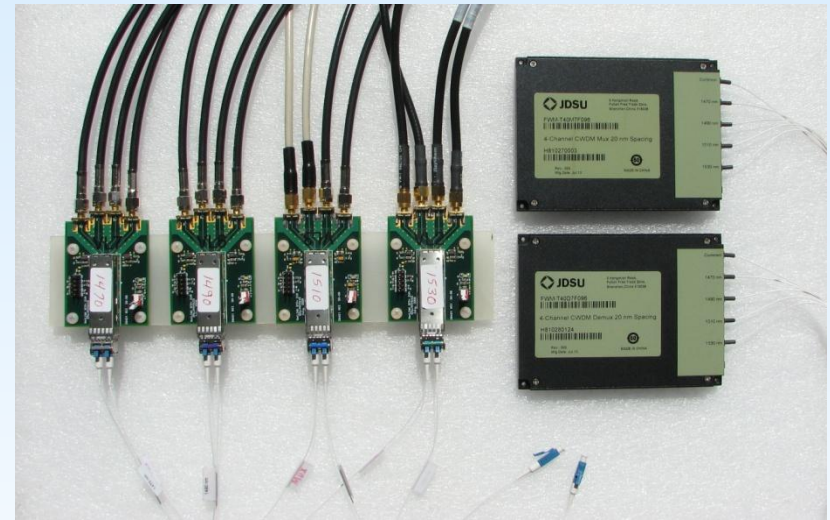
CWDM: Coarse Wavelength Division Multiplexing

$\lambda_1 = 1470 \text{ nm}$ $\lambda_3 = 1510 \text{ nm}$
 $\lambda_2 = 1490 \text{ nm}$ $\lambda_4 = 1530 \text{ nm}$

CWDM/Free-Space Bit Error Rate Testing With Vega Wave Systems

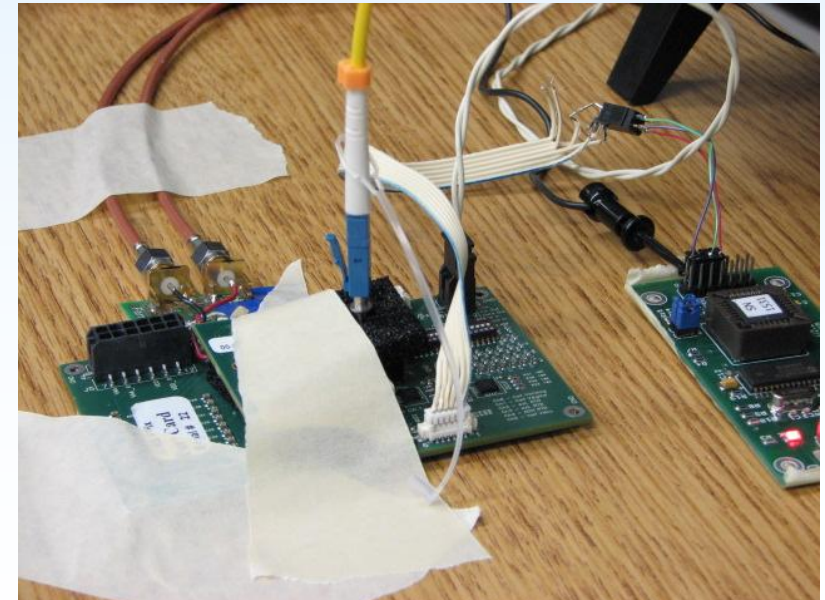
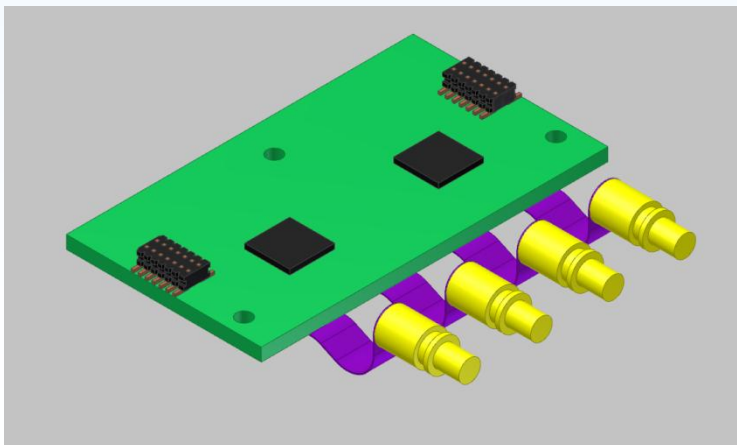
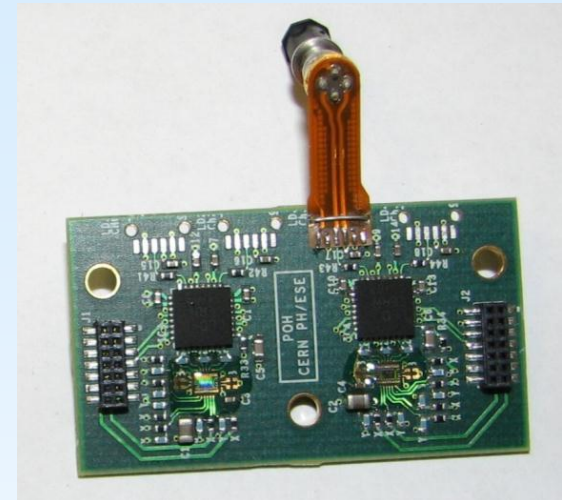
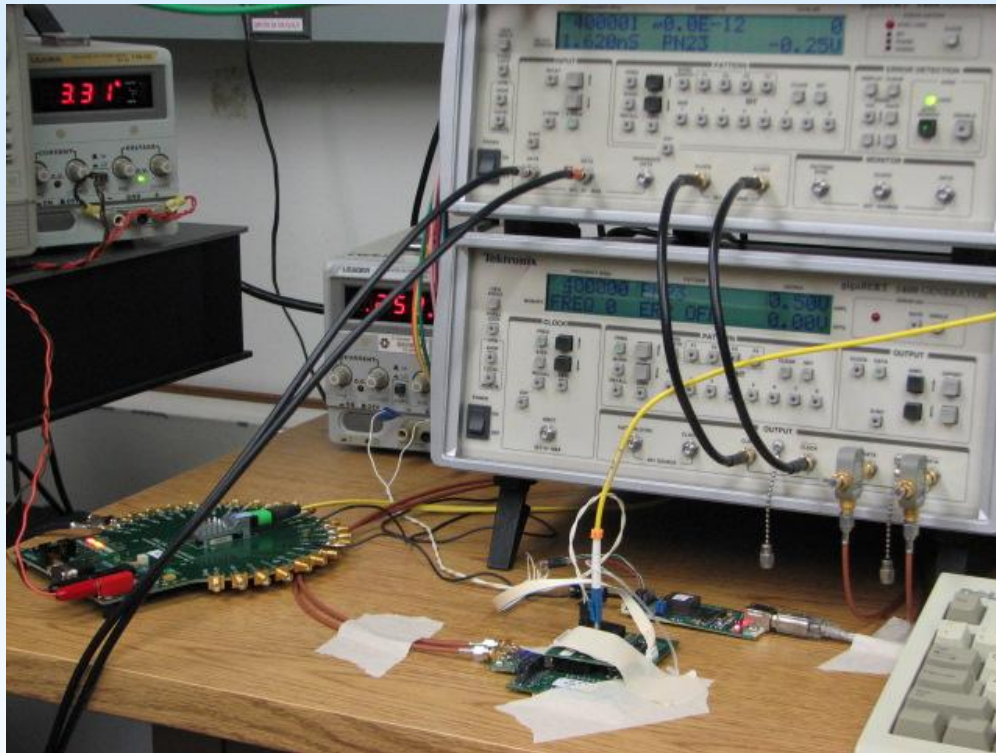


Optical Breadboard with Silicon Samples

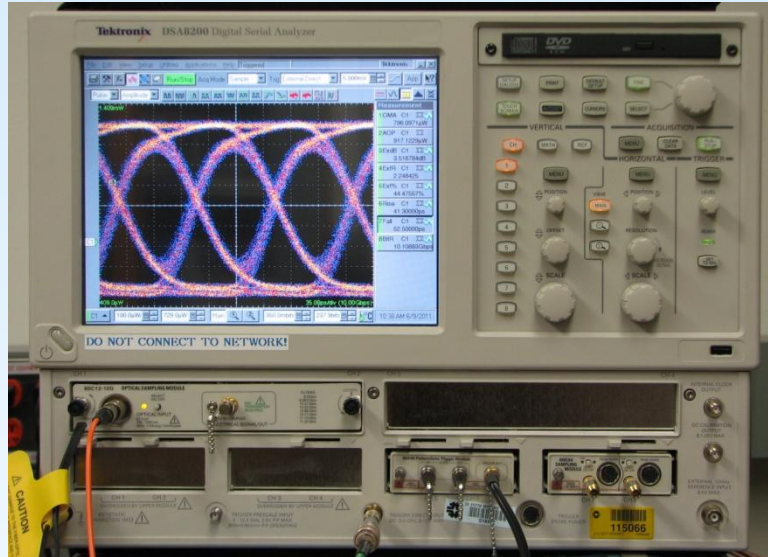


Wavelength Division Multiplexing Components

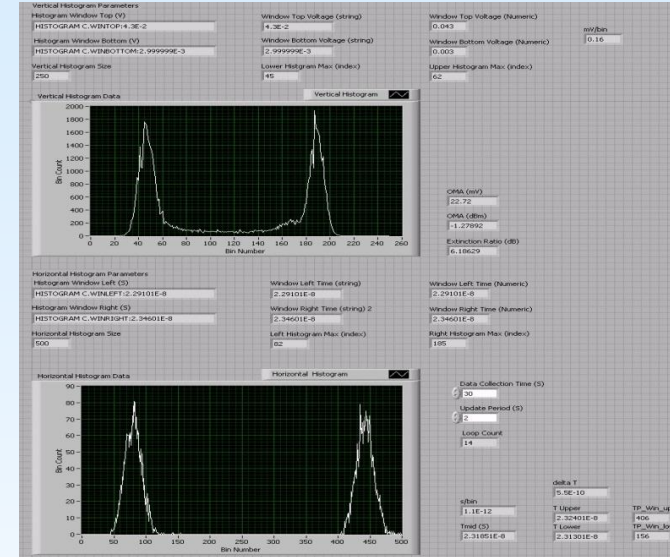
CMS Phase 1 Pixel OptoHybrids



Digital Signal Analyzer (Eye Patterns, Jitter)



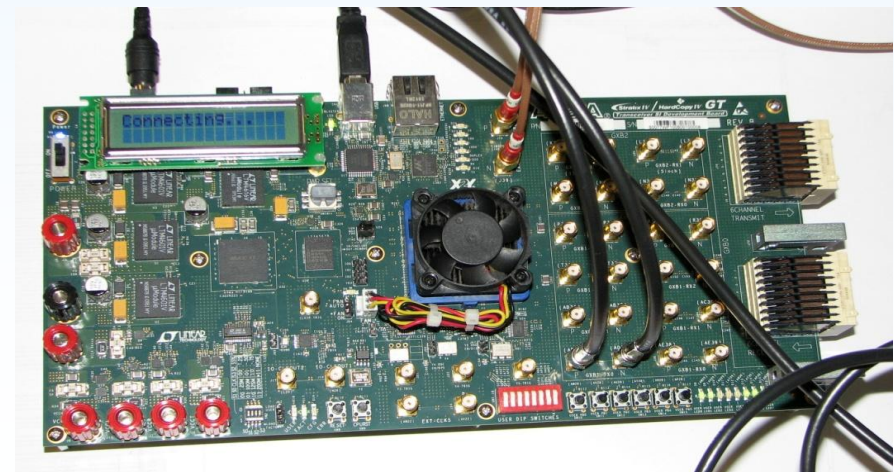
Labview VIs (Histogram Analysis)



Variable Optical Attenuators (Receiver Sensitivity)



FPGA Signal Integrity Kit (BERT, PRBS Generation)





**“High Bit Rate Data Links for Collider Experiments” LAB 11-438
Proposal (Office of Science)**

Submitted March, 2011

Collaborating Institutions Include ANL, FNAL, Vega Wave Systems

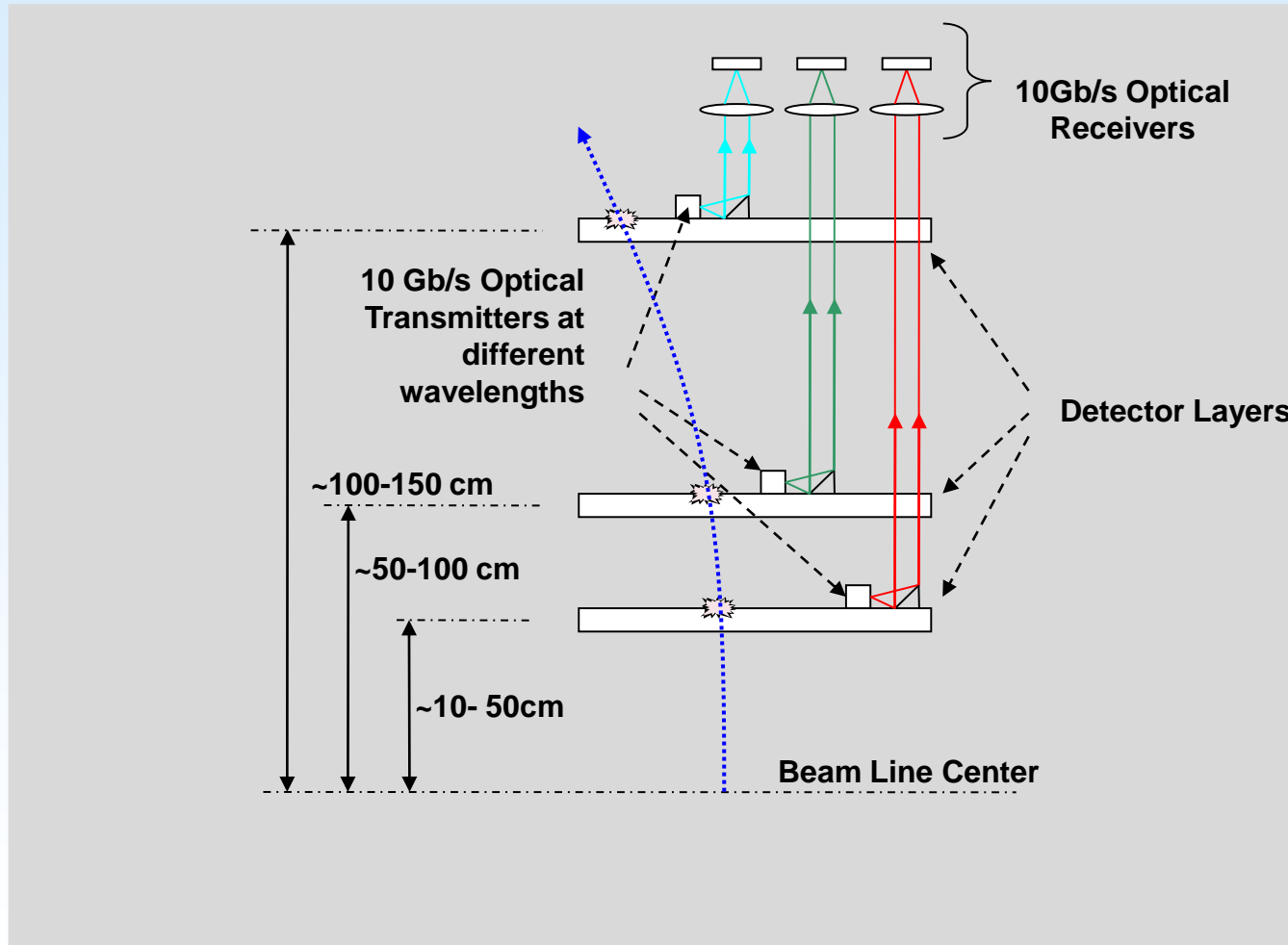
Common Interests:

**Free Space Optical Links
Low Power Optical Modulators**

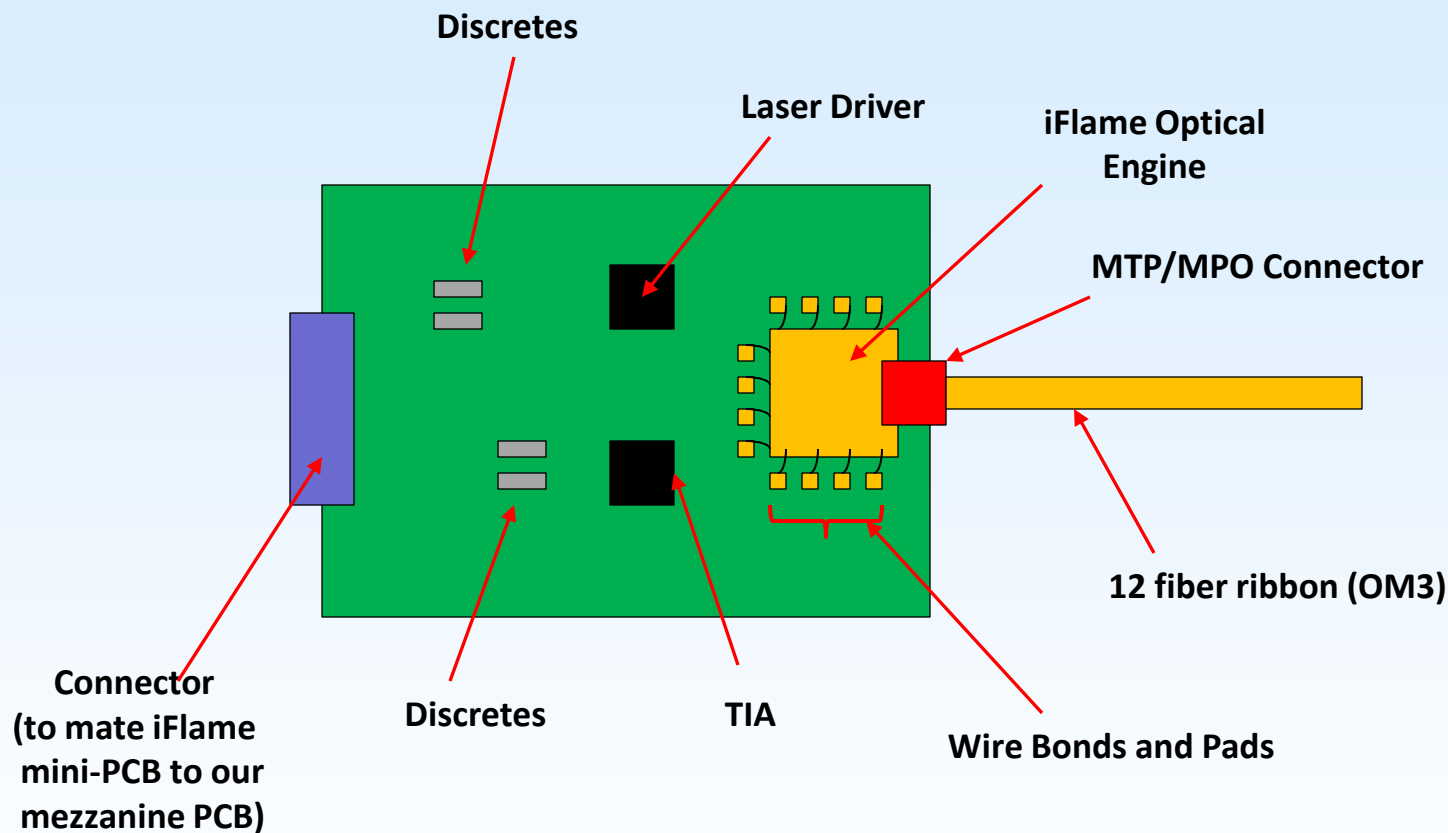
Additional Area of Interest:

120 Gbps Array-Based Links for Detector Readout

Multi-Gbps Free Space Detector Readout

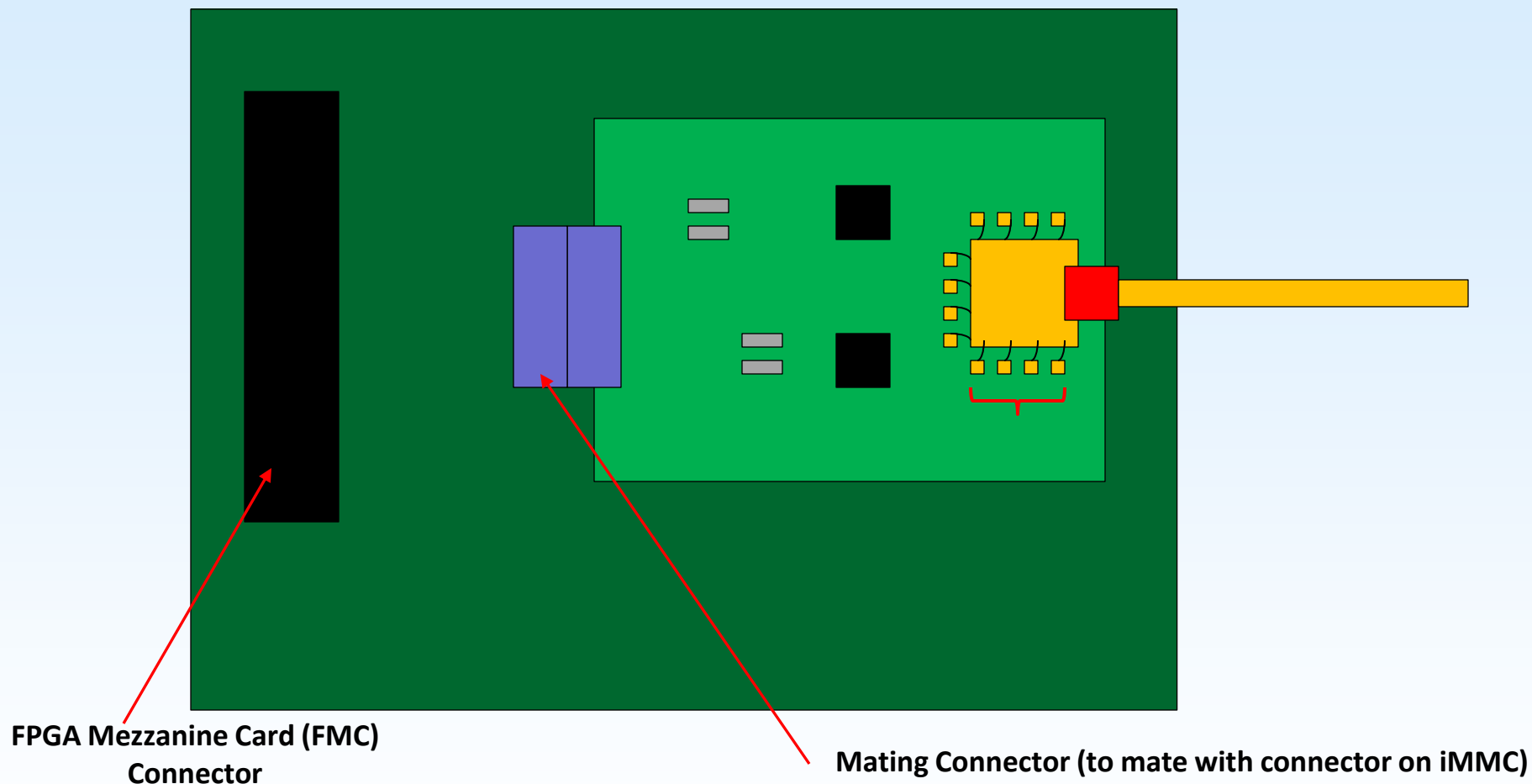


iFlame Mini-Mezzanine Card (iMMC) Concept (On Detector Arrays)



Concept: Fermilab would produce a pluggable mezzanine card (to be called the iMMC) with the iFlame mounted on-board. This card would require the addition of laser drivers and TIAs respectively for the transmitter and receiver interfaces on the iFlame. Fermilab would purchase iFlames from Xloom and separately purchase laser driver and TIA components from other vendors, following Xloom's guidance. In addition, Fermilab would follow Xloom guidance on the connector (left side of board) to mate the iMMC to a carrier card (see next slide).

iFlame Mini-Mezzanine Card (iMMC) Concept (On Detector Arrays)



FPGA Mezzanine Card (FMC)
Connector

Mating Connector (to mate with connector on iMMC)

Concept: Fermilab would also produce a carrier card to support the iMMC mezzanine card. This card will be designated as the iMMC Carrier. This card would be equipped with FMC connectors (left side) so that it could be interfaced to an FPGA equipped board over an FMC connector.

Such boards are available from 3rd party vendors. Fermilab could then test the combination of the iMMC Carrier hosting the iMMC and distribute these two boards to collaborators for their own investigation. In addition to providing access to iFlame technology, it provides Fermilab with valuable experience in designing with the iFlame technology for possible future use as miniature optical engine assemblies for use on detector.